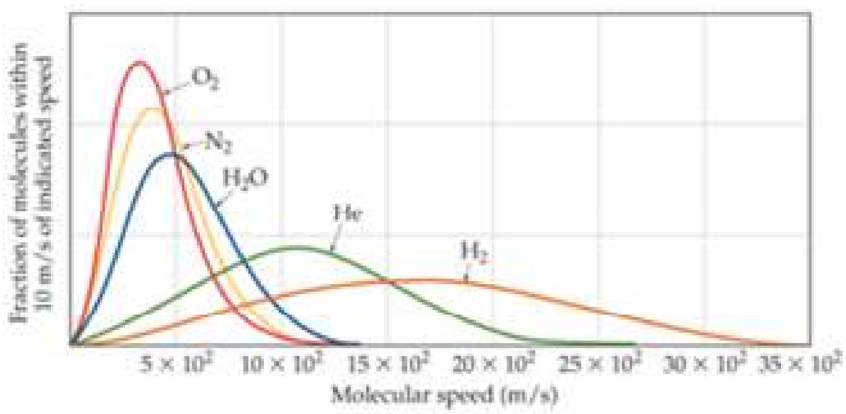
Name ____ AP Chemistry

Molecular Speed of Gas Particles and Real Gases

Molecular Speed of Gas Particles

According to the Kinetic Molecular Theory, the kinetic energy is proportional to the temperature of the gas. In other words, the higher the temperature, the more kinetic energy the gas particles contain. Two ideas can be raised from this statement: how does the identity of the gas affect the movement of the gas particles and can the speed of the gas particles be measured?

Below is graph, showing several different compounds and their speeds:



The trend observed in this graph is:

Using the formula of kinetic energy ($k = \frac{1}{2}mu^2$), the speed of a gas can be determined with the following equation:

<u>Example:</u>

Calculate the rms (root-mean-square) speed (u) of an N_2 molecule at 25°C.

Practice Problems:

*Includes both questions on molecular speeds but also Graham's law.

1) (a) Place the following gases in order of increasing average molecular speed at 300 K: CO, SF_6, H_2S, Cl_2, and HBr.

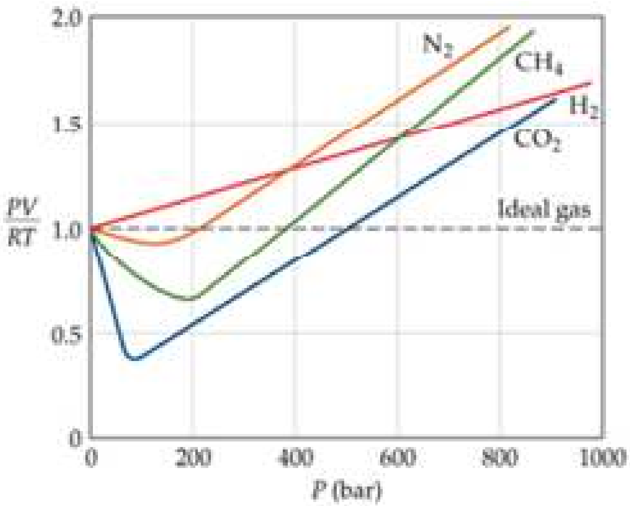
   (b) Calculate and compare the rms speeds of CO and Cl_2 at 300 K.

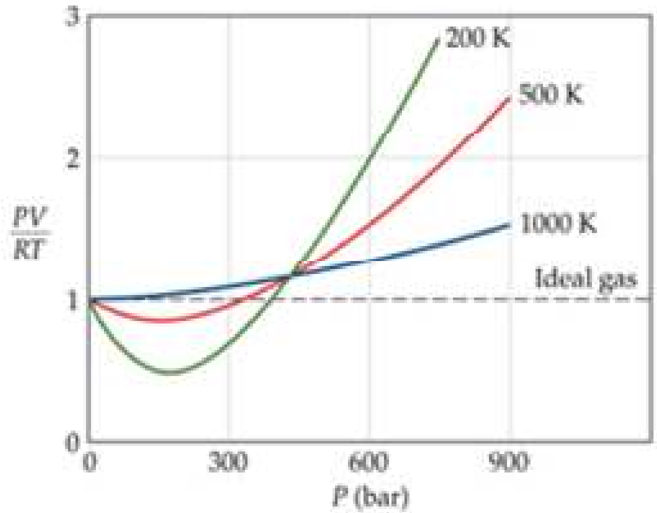
2) Calculate the root mean square velocities of CH_4 and N_2 molecules at 273 K and 546 K.

3) Arsenic (III) sulfide sublimes readily, even below its melting point of 320°C. The molecules of the vapor phase are found to effuse through a tiny hole at 0.28 times the rate of effusion of Ar atoms under the same conditions of temperature and pressure. What is the molar mass of arsenic (III) sulfide?

4) Freon-12 is used as a refrigerant in central home air conditioners. The rate of effusion of Freon-12 to Freon-11 (molar mass = 137.4 g/mol) is 1.07:1. The formula of Freon-12 is one of the following: CF_4, CF_3Cl, CF_2Cl_2, $CFCl_3$, or CCl_4. Which formula is correct for Freon-12?

Real Gases





An ideal gas is only a theoretical idea, but most gases obey the ideal conditions. However, in certain conditions, real gases deviate from the ideal conditions. Based on the two graphs above, those two conditions are: